Differences in middle school science achievement by school district size

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ABSTRACT

This study examined differences in Texas middle school student achievement in science by school district enrollment size. Quantitative research utilized analysis of variance to determine whether significant differences existed between student achievement on the 2010 Texas Assessment of Knowledge and Skills 8th grade science results and four school district enrollment size groups. A significant difference was found between means of small district science scores and medium, large, and mega district science scores.

Keywords: achievement, science education, school size

INTRODUCTION

Almost one third of all American students are taught in small or rural schools in the United States, with 27% of public school students attending a school in a community of less than 25,000 and 19% attending schools in communities of less than 2500 (Johnson & Strange, 2005). Finding true rural solutions to rural problems has become the crux of the debate; moreover, it is imperative that urban or suburban solutions not be superimposed upon rural education. Often, suburban curriculums and large school educational models are given to rural schools as examples (Bard et al., 2006). Rural schools utilize urbanized science curriculum models due to the lack of science curriculum specifically designed for rural and small schools (National Science Foundation, 2001). However, adopting approaches used in urban settings have not yielded results or closed the achievement gaps in rural settings (Beecher & Sweeny, 2008; ACT, 2006; and Education Trust, 2006a, 2006b). High quality staff development on curriculum development and implementation of effective teaching practices is needed not only for suburban and large schools but also for educators in rural and small schools (Mollenkopf, 2005).

Additionally, traditional methods of instruction have been replaced with faster and more interactive means, including online classes and virtual classrooms (Aronson & Timms, 2004). Technology has created new ways to exchange ideas, information, and knowledge. The marketplace of ideas has grown to include the entire planet and students can access this instantaneously. Providing equitable experiences for all students is essential (Scheurich & Skrla, 2003) for closing performance gaps within groups. Science relies heavily on lab equipment and technology and teacher expertise, both of which are traditional barriers for rural education (Russon, Stark & Horn, 2000).

Moreover, Hartlep (2009) stated that school curricula are structured exclusively to conventional white middle class values. Hackman and Rauscher (2004) noted that personal perspectives are not valued within mainstream curriculum, which denies the core of essence of place and what it is to be rural. A more equitable system, inclusive of the needs of marginalized groups, is certainly considered necessary (Hackman & Rauscher, 2004).

Thus, for the rural school administrator, providing resources including curriculum development and planning at the campus level proves a critical responsibility because it is vital to student success. Due to a lack of financial resources and faculty expertise (Hannum, Irvin, Banks, & Farmer, 2009), providing rigorous comprehensive curricula for student success in rural schools challenges administrators daily. Finding new solutions to rural problems are imperative to rural student achievement in science.

In fact, rural school consolidation has often been suggested by lawmakers and politicians as a solution for difficult questions and issues that face rural and small schools throughout the United States. The consolidation of schools has been a contentious subject for years and has impacted rural communities since the early part of American history (Bard, Gardener, and Wieland, 2006, p. 40). DeYoung and Howley (1992) explain, “As rural and small schools are typically the target of school consolidation, the threat of school closures persists as perhaps the most important concern in American rural communities” (p. 3). To date, research has been inconclusive on the subject of school size as to whether larger schools or smaller schools truly impact student achievement. The most recent research indicates that smaller and rural schools have the edge over larger schools, and older research tends to favor larger schools (Gregory, 2000, p. 2).

Additionally, small, rural schools, are more likely to be poor and serving large minority populations, and have more educational issues and fewer resources to overcome these barriers (Farmer, Irvin, Thompson, Hutchins, & Leung, 2006; Johnson & Strange, 2005; Khattri, Riley, & Kane, 1997). However, research has shown that rural and small schools have an advantage for economically disadvantaged students (Cotton, 1996). These findings were confirmed in the Matthew Project that examined student achievement and school district size with socioeconomic status. One of the major conclusions was that, communities with higher percentage of children living in poverty have better performance when the schools are smaller (Howley & Bickel, 1999).

Thus, the purpose of this study was to determine whether school district enrollment size impacts student achievement, including the subpopulation of economically disadvantaged students (as labeled by the Texas accountability system), on the 2010 8th grade science Texas Assessment of Knowledge and Skills (TAKS). The research questions addressed differences in student achievement on the 2010 TAKS 8th grade science assessment results by school district enrollment size and differences in economically disadvantaged student performances by school district enrollment size.

METHOD

Quantitative research utilized analysis of variance to determine whether significant differences existed between student achievement on the 2010 Texas Assessment of Knowledge and Skills 8th grade science results and four school district enrollment size groups. The population in the quantitative study was all independent school districts in Texas that reported 8th grade Texas Assessment of Knowledge and Skills Science test in 2010. The Texas Education Agency reported 346,099 students in the 8th grade were registered in Texas public schools for the 2010 school year and 1107 school districts reported TAKS results. School district enrollments ranged from 204,245 total students in the Houston Independent School District to 33 total students in the Legends Academy (Texas Education Agency, 2011).

The data were retrieved from the Texas Education Agency website and a data file was created from all Texas school districts reporting 2010 TAKS 8th grade science scores. The school districts were distributed into four categories by size. The small size school districts ranged from 33 students to 550 students, medium size districts were 551 students to 1500 students, large size districts were 1501 students to 6000 students, and mega size districts were 6001 students to 202,773 students.

The 2010 8th grade science Texas Assessment of Knowledge and Skills is a standardized test taken by public school students in Texas, and the grade level for testing ranges from 3rd grade until high school exit level (Texas Education Agency, 2011). The TAKS assessments are standard based assessments that were directly connected to the Texas Essential Knowledge and Skills standards and the test validity was bound to the curriculum of the state. The reliability of the TAKS test was measured by the Kuder-Richardson Formula 20 (KR20) with a reliability coefficient ranging from .87 to .90 with a 1.0 being no error in reliability (Texas Education Agency, 2008).

RESULTS

Analysis of Science Scores by District Size

The dependent variable for the first ANOVA was 8th grade science TAKS score district averages. The independent variable was district enrollment size. The ANOVA was significant, $F(3, 1103) = 6.287$, $p = .000$, and null hypothesis was rejected. The effect size, assessed by η^2 was small with the size of the district accounting for 2% of the variance of the dependent variable. The population size and mean science test scores for districts are listed in Table 1 (Appendix).

The district enrollment category averages of 8th grade science TAKS scores were tested for significant differences. There was a difference between means of small district science scores and medium district science scores at the .05 level $p = .000$. A difference existed between means of small and large district scores at the .05 level $p = .028$. A difference was found between means of the small and mega district scores at the .05 level $p = .001$. No difference existed between means of medium and large district scores at the .05 level $p = .231$. No difference was found between means of medium and mega district scores at the .05 level $p = .612$. No difference existed between large and mega district science scores at the .05 level $p = .144$ as reported in Table 2 (Appendix).

Analysis of Economically Disadvantaged Identified Achievement and District Size

A one-way analysis of variance (ANOVA) was conducted to compare 2010 TAKS 8th grade science assessment results of students identified as economically disadvantaged and the four district enrollment groups. The ANOVA was significant, $F(3, 1034) = 5.766$, $p = .001$ and the null hypothesis was rejected. Effect size, assessed by η^2, was small with the size of the district only accounting for 2% of the variance of the dependent variable. The population size and mean science test scores for districts are listed in Table 3 (Appendix).

Supplementary tests were conducted to determine differences between the school district enrollment sizes and economically disadvantaged identified student achievement as measured by the 2010 TAKS 8th grade science assessment. There was a significant difference between the means of the small district science scores and the medium district science scores at the .05 level $p = .000$. A significant difference existed between the means of small and large district scores at the .05 level $p = .047$. A difference existed between the means of small and mega district scores at the .05 level $p = .004$. No difference was found between means of medium and large district science scores at the .05 level $p = .101$. No difference existed between means of medium and mega district scores at the .05 level $p = .861$. No difference existed between large and mega district scores at the .05 level $p = .243$ as reported in Table 4 (Appendix).

The results of the 2010 8th grade science TAKS scores for the four district enrollment sizes for all students indicated that mega districts scored highest. However, medium districts scored just below mega districts and higher than large districts. Small districts scored lowest. The difference was significantly lower than the three larger district groups. Effect size was small representing 2% of the variance.

The results for economically disadvantaged identified students for the four district enrollment sizes indicated that medium districts scored highest. The mega districts scored slightly lower than medium and large districts. The small districts' students scored significantly lower than the three larger district groups. Effect size was small representing 2% of the variance dependent upon school size.

CONCLUSIONS

Problems that have plagued the rural schools continue to create an achievement gap on the 2010 Texas Assessment of Knowledge and Skills 8th grade science in the very smallest of rural schools in Texas. However, Texas school districts that have more than 550 and less than 1500 students had very competitive scores on the 2010 Texas Assessment of Knowledge and Skills 8th grade science assessment than much larger school districts. Economically disadvantaged students performed the highest in medium sized Texas school districts on the 2010 Texas Assessment of Knowledge and Skills 8th grade science. Students, including economically disadvantaged students perform more poorly on the 2010 Texas Assessment of Knowledge and Skills 8th grade science in small schools than in medium, large, or mega districts in Texas. Data from this study seemed to support previous research that noted a critical component to increasing student achievement within small schools is the level of rigor that can be reached within an environment of limited resources (McAndrews & Anderson, 2002; Russon, Stark, & Horn, 2000).

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APPENDIX

Table 1
8^{th} Grade Science TAKS Scores for Four District Enrollment Sizes (N = 1135)

Variable	*N*	*M*	*SD*
Small District	386	74.580	17.478
Medium District	322	78.447	12.478
Large District	250	77.052	9.648
Mega District	149	79.141	9.648

Table 2
Bonferroni Comparison of School District Enrollment Size and 8^{th} Grade Science Scores

School Sizes Comparisons	Mean Score Difference	Std. Error	Significance *p*
Small to Medium	-3.867	1.043	.000*
Small to Large	-2.472	1.122	.028*
Small to Mega	-4.561	1.333	.001*
Medium to Large	-1.395	1.165	.231
Medium to Mega	-.694	1.369	.612
Large to Mega	-2.089	1.430	.144

*. The mean difference is significant at the .05 level.

Table 3
8^{th} Grade Science TAKS Scores for Economically Disadvantaged Identified Students for Four District Enrollment Sizes (N = 1038)

Variable	*N*	*M*	*SD*
Small District	320	67.450	19.709
Medium District	318	72.091	14.621
Large District	249	69.996	11.551
Mega District	148	71.831	8.925

Table 4
Bonferroni Comparison of School District Enrollment Size and 8th Grade Science Scores for Economically Disadvantaged Identified Students

School Size	Mean Scores	Std. Error	Significance *p*
Small to Medium	-4.644	1.197	.000*
Small to Large	-2.546	1.257	.047*
Small to Mega	-4.381	1.505	.004*
Medium to Large	2.098	1.278	.101
Medium to Mega	.263	1.480	.861
Large to Mega	-1.835	1.570	.243

*. The mean difference is significant at the .05 level.